

PIOX[®] R

Process Analytics by Inline Refractometry

Concentration Measurement

Process Control

Conversion Rate Determination

Phase Detection

Product Identification

Density Measurement

**Process Insight
Through Transmitted Light**



PIOX® R

Process Analytics by Inline Refractometry

Refractometry - in other words, the measurement of light refraction - is a well-established method of choice for determining the **concentration, density and purity of many liquids**.

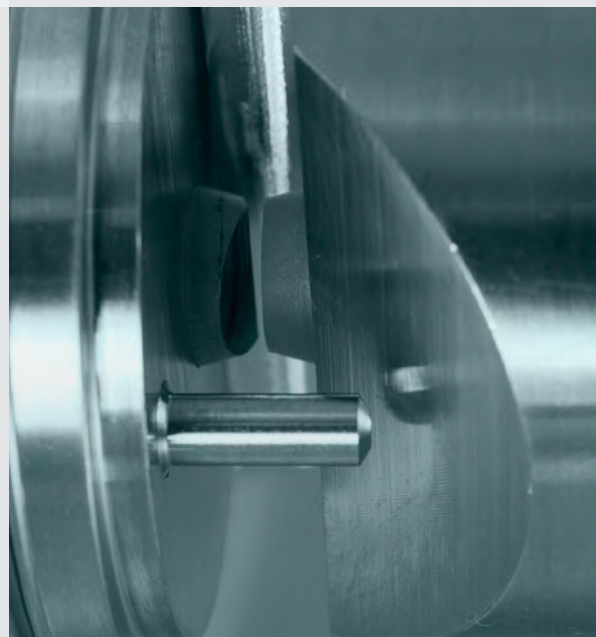
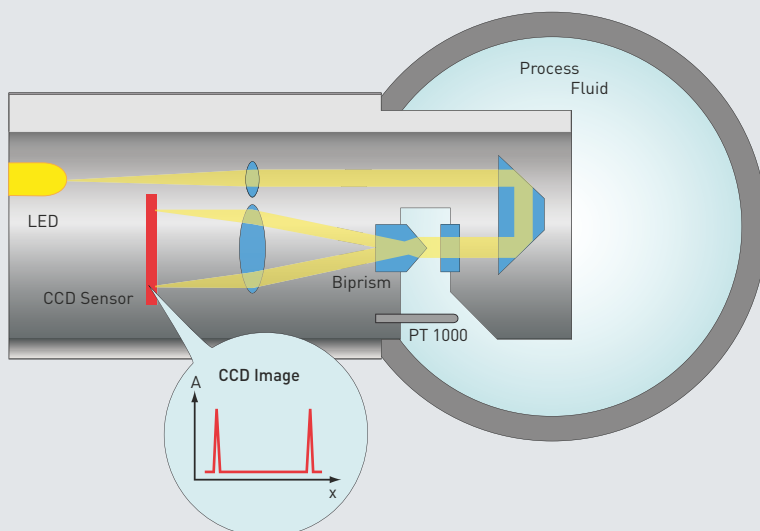
By measuring the refractive index directly within the process, PIOX® R allows for a **highly accurate measurement, long term reliability and continuous quality management** either in hygienic and ultraclean sanitary or harsh industrial environments with high process pressures, temperatures and corrosive media.

Unlike other available measurement technologies, FLEXIM's PIOX® R employs its **patented transmitted light principle** and thus never bears the risk of measurement drift and false readings from deposit build up at the prism.

The unrivalled design and the integrated diagnostic tools moreover allow for **very cost effective and predictive maintenance intervals**.

Benefits:

- Patented transmitted light measurement principle - offers completely drift free, precise and long term stable measuring
- No flow velocity needed - which is required from conventional technologies
- Highly precise optical measurement technology offering laboratory accuracy in real-time
- Measurement unaffected by gas bubbles and turbidity as well as the media's viscosity
- Internal self-diagnostic tools for predictive and very cost effective maintenance efforts





PIOX® R – Chemical Design variant

The concentration analysis of liquid media is one of the most critical parameters for a proper process and quality control within the Chemical Industry.

By measuring the refractive index, concentration levels of many media consumed or created within the chemical and textile fiber industry, such as solvents, acids, caustics as well as other - often corrosive and toxic - intermediate and end products, can accurately be monitored and a total quality control be assured.

FLEXIM offers its PIOX® R Process Refractometer in two distinct Chemical Design variants:

Both designs are highly durable against any corrosive and toxic media due to their internal FFKM gaskets, scratch resistant sapphire optics, as well as the complete separation of the sensor head from the electronics compartment.

For measuring toxic and corrosive organic as well as inorganic media, PIOX® R is offered as a fully stainless steel design variant with all wetted materials made out of grade 316 Ti / 1.4571 steel.

When measuring in highly corrosive media, such as hydrochloric, strong sulfuric or hydrofluoric acid, PIOX® R is available as a special carbon fiber reinforced PTFE design variant offering an unrivalled corrosion resistance, long term stability and reliability in such harsh environments.

Being ATEX Zone 0/1, 1 and 2 certified and available with long and short sensor heads that can be integrated into the process via DIN / ANSI flange or the proprietary FLEXIM flow cell, PIOX® R is the ideal process analytical technology for a wide array of liquid media within the chemical industry.



Case study: Concentration measurement of Dimethylformamide (DMF)

For the spinning of textile acrylic fibers, polyacrylonitrile powder is dissolved in dimethylformamide (DMF). In order to reprocess the DMF, it becomes vaporized and later condensed, resulting in a 90% DMF solution. To also recollect the DMF still residing in the acrylic fibers, these are washed out and the rinse solution, which contains 10% - 15% DMF, is distilled up to a concentration level of about 60% DMF.

However, for a re-usage of the DMF within the process, it has to be pure. This is achieved by reclaiming it in the main distillation column. The main distillation column operates at its efficiency peak if the DMF solution entering the column is about 85%. In order to obtain this concentration level, the 90% DMF solution from the first and the 60% DMF solution from the second recollection step are mixed.

PIOX® R monitors the correct mixing to a concentration level of 85% DMF and thus ensures, that the distillation process is always operating at its peak efficiency.

Advantages:

- Continuous concentration monitoring allowing for a real time process operation at peak efficiency
- Reliable and exact measurement without drift and minimal maintenance efforts
- PIOX® R inline technology allowing for a completely closed process and making costly laboratory testing obsolete

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$n = \arcsin(n_1 / n_2)$$

C_{Vacuum}
 C_{Medium}



Case study: Concentration measurement of Hydrochloric Acid

For the production of polyurethanes, MDI (methylene diphenyl diisocyanate) and TDI (toluene diisocyanate) are used as educts. During the production process of MDI and TDI, hydrochloric acid is created as a byproduct which will later be used as a raw material for many other chemical processes.

Thus, it is important to closely monitor the concentration levels of the hydrochloric acid after purification with a high degree of accuracy and reliability. In the case of a large TDI production plant in Germany, the HCl concentration level has to be close to 17% before forwarding it to other processes.

Here, the PIOX® R Process Refractometer is used to monitor the concentration level in real time. Due its internal gasket design and the PTFE sensor coating, the refractometer does not suffer from corrosion and offers long term stable and precise measurement results.

Advantages:

- High measuring accuracy and long term reliability in highly corrosive environments
- Continuous quality control, ensuring compliance with process and environmental standards
- Virtually maintenance free and no measurement drift



PIOX® R - Process Refractometer

FLEXIM has a large library of fluids for measuring concentration, density and purity of liquids that continues to grow*:

Media list for PIOX® R - Chemical Design variant	
→ Amines	→ Glycerin
→ Ammonia	→ Hydrochloric Acid
→ Aniline	→ Hydrofluoric Acid
→ Brine Solutions	→ Isocyanates
→ Caprolactam	→ Lubricating Oils
→ DMAC (Dimethylacetamide)	→ Nitric Acid
→ DMEA (Dimethylethanolamine)	→ NMP (N-Methyl-2-Pyrrolidone)
→ DMF (Dimethylformamide)	→ Polycarbonates
→ Ethanol, Methanol, (Iso)propanol	→ Raffinates
→ Ethylen- & Propylenglycol	→ Sodium Hydroxide
→ Formaldehyde	→ Sulfuric Acid
→ Fungicides	→ Urea

**Note: Table does not include all fluids in the FLEXIM library. If you do not see your fluid or requirements listed, contact your local FLEXIM representative at www.flexim.com/contact for verification, or email us at info@flexim.com.*

Continuous Process Control with Laboratory Accuracy

PIOX® R combines long term reliability with very high measuring accuracy. Based on innovative and sophisticated technology, the patented process refractometer allows for implementing the well-established laboratory method even under the most challenging conditions of industrial production.

PIOX® R offers, in conjunction with FLEXIM's PIOX® S ultrasonic analyser, the possibility of measuring solutions containing two or three different media, when combining with other substance specific measures (e.g. sonic velocity, density or conductivity).

PIOX® R Performance Guarantee

We know our applications well, and coupling this with a large installed base, FLEXIM guarantees that your PIOX® R system measures to your required accuracies or you get your money back.

Ready to Get Started?

Feel free to contact FLEXIM or your local Sales Representative to get started with your PIOX® R measuring system. We look forward to responding to your inquiry!

FLEXIM

More than 20 years
of experience in Process
Analytical Technology



PIOX® R is available in the following variants:

In its Chemical Design variant, PIOX® R offers, due to its internal gasket design, the mechanical separation of the sensor head from the electronics compartment as well as the highly corrosion resistant housing materials, the highest possible process safety for a reliable measurement of corrosive and toxic media.

In the Hygienic Design variant, PIOX® R is the ideal Process Refractometer for quality assurance applications found in the pharmaceutical and beverage industries. Being dead space free due to its patented design concept, there is no room for bacterial contamination. Moreover, the systems measurement accuracy and reliability is totally independent of potential deposits on the prism.

PIOX® R	Process Refractometer Measurement according to the patented Transmitted Light Principle
Measuring quantities	(temperature compensated) Refractive index, media temperature, ° Brix (Plato, Oechsle), w%, additional quantities programmable
Measurement range	nD: 1.3 ...1.7, °Brix: 0 ...100
Measurement accuracy	nD: 0.0002 (corresponds to: 0.1 °Brix, 0.1 w%)
Operating temp. (media)	- 20 °C ... (+ 130 °C) + 150 °C
Fluid pressure:	PN 10, PN 16, on request PN 40 (depending on process connection)
Degree of protection / Explosion protection:	Sensor: IP67, ATEX (IECEX) Zone 0/1, 1, 2 Transmitter: PIOX® R704: IP65, ATEX (IECEX) Zone 2 optional PIOX® R705: IP66, stainless steel enclosure, ATEX (IECEX) Zone 2 and FM Class I, Div. 2 optional PIOX® R709: 19 inch rack version, IP20
Chemical Design variant	
Wetted parts, materials:	Stainless Steel 316Ti (1.4571)
Housing material:	Stainless Steel 304 (1.4301)
PTFE Chemical Design variant	
Wetted parts, materials:	Completely PTFE
Housing material:	Epoxy resin coated Stainless Steel 304 (1.4301)
Process connection:	DIN/ANSI flange, proprietary FLEXIM flow cell
Hygienic Design variant	
Wetted parts, materials:	Stainless Steel 316L (1.4404)
Housing material:	Stainless Steel 304 (1.4301)
Process connection:	Compatible to Varivent or Tri-clamp connection

FLEXIM GmbH

Berlin, Germany
Phone: +49 30 93 66 76 60
info@flexim.com
www.flexim.com

FLEXIM Instruments Benelux B.V.

JX Berkel en Rodenrijs, Netherlands
Phone: +31 10 24 92 333
benelux@flexim.com
www.flexim.com

FLEXIM Instruments UK Ltd.

Northwich, United Kingdom
Phone: +44 1606 781 420
sales@flexim.co.uk
www.flexim.co.uk

FLEXIM Service and Support Center South America

Esco Argentina S.A.,
Buenos Aires, Argentina
Phone: +54 11 49 20 71 00
flexim@escoarg.com.ar
www.escoarg.com.ar

FLEXIM Instruments Asia Pte Ltd.

Singapore, Singapore
Phone: +65 67 94 53 25
salessg@flexim.com
www.flexim.com

FLEXIM Instruments China

Shanghai, China
Phone: +86 21 64 95 75 20
shanghai@flexim.com
www.flexim.cn

